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GROWTH INDICES AND PROFITABILITY OF FEEDING COBB-BROILER CHICKENS WITH A LOW PROTEIN COMMERCIAL DIET SUPPLEMENTED WITH A PROTEASE

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ABSTRACT

Ninety-six day-old broiler chicks were allotted to four dietary treatments in a completely randomized design to investigate the effect of feeding a mono-component protease added to a low protein diet. There were three replicates per treatment and 8 birds per replicate. Protease supplementation at 0g, 0.25, 0.5 and 0.75g/kg of feed were the dietary treatment and birds were fed for 6 weeks. Body weight gain (BWG), growth efficiency (GE) and protein efficiency ratio (PER) were significantly affected by the addition of protease to the commercial diet. Feed intake (FI), energy efficiency ratio (EER) and cost of feed intake were affected significantly prove by protease addition at 0-42 days. Broiler chickens fed the recommended level of protease, 0.5g/kg T3, had growth performance comparable if not better than birds fed the control diet without protease. Birds on the level of protease lower or higher than the recommended level, 0.25g/kg and 0.75g/kg diet consistently performed poorer than birds on the control diet and those fed the recommended level. There was no increase in cost of feed consumed as a result of protease addition to the commercial diet but the profit margin was increased significantly with the addition of 0.5g/kg protease.

Keywords: Broiler chickens, Growth indices, Performance, Profitability, Profit margin, Protease

INTRODUCTION

In Nigeria, livestock feed producers use variable ingredients. This practice is largely dependent on availability and affordability of these variable ingredients. A number of times, the quality of such ingredients is compromised for a number of reasons including competition with man. Though NRC, (1994) recommends 23% crude protein in broiler chicken diets during the starter phase and 18% during the finisher phase, commercial broiler feed producers tend to reduce the crude protein content as sometimes declared on their content labels. This is to reduce feed production costs and maximize profit, since crude protein (CP) is a major cost contributor to the final feed cost (Kamran *et al.,* 2004). With the high cost of protein ingredients, reduction of total dietary nitrogen and digestible amino-acids could lead to economic advantages in feed formulation. On the other hand, excess protein in the large intestine could lead to energy loss by the animal due to the need to detoxify products of amino-acid degradation resulting from microbial fermentation (Marks and Pesti, 1984; Adeola and Cowieson, 2011). Furthermore, nitrogen reformulation in the environment is an important issue and an important reason for CP reduction in animal diets, especially in areas of intensive animal production.

Dietary protein is crucial to growth (Laudadio *et al.,* 2012), reproduction and gastro Intestinal Tract (GIT) development; as a result, the practice of reducing CP content of feeds became a major concern to farmers and the success of their production ventures. A number of work had been done on the effect of feeding low protein diets to broiler chickens, while some researchers have reported poor performance (Berres *et al.,* 2010), others reported no significant effect (Widyaratne and Drew, 2011) and some reported improvement when fed under warm climatic conditions (Thim *et al.,* 1997). It is known that enzyme used in poultry feeds increase feed value by way of improving nutrient availability and digestibility (Yuan *et al*., 2008; Ajayi and Iyayi, 2014), with a resultant improvement in performance and reduction in viscosity of intestinal content (Bedford, 2001; Yuan *et al.,*

2008; Agboola *et al*., 2014; Agboola *et al*., 2015). Many researchers fed multi component enzymes to broiler chickens but with varied results, some of the observed effects could not be attributed to any of the enzymes in the cocktail but mostly explained as a synergistic effect of the interplay of all enzymes in the mix. Tiwari *et al.* (2010) reported that phytase in the enzyme mix used was more beneficial to birds than the protease in the mix, which was why most feed enzymes came in cocktails. According to Torres-Rodriguez *et al*. (2005), Angel *et al*. (2005) and Houshmand *et al.* (2012), feed additives may be more efficient when low nutrient levels were fed. These additives have been fingered to lead to better gut health leading to better performance generally.

Some researchers have suggested that feed additives increased activity of beneficial microorganisms which were antagonistic to pathogenic ones (Kizerwetter-Swida and Binek, 2009), enhanced nutrient uptake (Agboola *et al.*, 2014) and improved the immune system (Midilli *et al.*, 2008, Irani and Vincent, 2011). Bedford (2000) classified effects of enzymes on gut microflora into two phases: the ileal and caecal phases. He stated that enzymes reduce the number of bacteria in the ileum by increasing the digestion rate and reducing available substrates to the microbial population therein. Yang *et al*. (2009) in their review however suggested that the effect of enzymes on gut microflora may be more than in two phases.

In addition, farmers are interested in making profit whether the feed used was produced by them or purchased from commercial feed producer/sellers. Since feed cost account for about 70-80% of the cost of production, reduction in the cost of feed will increase the profit margin. Profit margin can also be increased if the amount of feed consumed by a bird was lower and its performance was maintained and not jeopardized. The question of how the total dietary N and digestible amino acids can be maximized in animal development and performance without jeopardizing them, remained to be answered.

In this study, the effect of supplementing a commercial diet (for broiler chickens) with a protease was investigated. The commercial diet had crude protein contents lower than the NRC recommended levels for broiler chickens for the starter and the finisher phases. Parameters investigated were growth performance of birds and the profitability of adding a protease to the commercial diet for 6 weeks.

MATERIALS AND METHODS

The experiment was carried out at the Teaching and Research Farm, Faculty of Agriculture and Agricultural Technology, Benson Idahosa University, Benin City, Edo State, Nigeria. The area lies within geographical coordinates of longitude 5° 04’ East and 6^{o} 43’ East and latitude 5^{o} 44^{0} and 7° 34’ North. The vegetation is tropical rainforest.

The mono-component protease (an endo-serine protease) with the trade mark Cibenza DP^{100} was used. Graded levels of the protease were added to a freshly made batch of commercial feed to give four (4) treatment diets. The enzyme was added by removing a part of the feed and making it up with same weight of enzyme followed by thorough mixing to ensure uniform spread as shown in Table 1.

Table 1: Protease matrix used

Treatment diets	Protease Level(g)	Amount of feed (g)	Total Matrix (g)
1	0	1000	1000
2	0.25	999.75	1000
3	0.50	999.50	1000
4	0.75	999.25	1000

Experimental diets and management of cobb-broiler chickens

Ninety-six (96) day old Cobb-broiler chickens strain were purchased from a reputable supplier, weighed and randomly allocated into four treatment groups of three replicates per treatment, to make twelve (12) experimental units. Each replicate group had eight chickens housed in 1.2m^2 deep litter pens. A 100 Watts electric bulb was suspended at 20 cm above the litter in each pen to generate heat for the brooding period of two weeks, after which the bulbs were raised gradually over time to reduce heat as appropriate. Birds in treatment 1 (control) received the diet without protease while birds in treatments 2, 3 and 4, received 0.25, 0.50 and 0.75g protease per kg of feed respectively throughout the experimental period. Starter period lasted for 0 – 3 weeks and the finisher period lasted for 3 – 6 weeks. Nutrient composition for the starter and finisher feeds as declared on feed bag label were as shown in Table 2.

Routine vaccines and medications were given according to management programme supplied by the hatchery through the supplier of the birds. Feed and water were supplied *ad libitum* throughout the 6 weeks of experimentation.

Table 2: Nutrient composition of the experimental feeds

Parameter	Starter feed	Expected level for starter feed*	Finisher feed	Expected level for finisher feed*
Crude protein (%)	22.00	23.00	18.00	20.00
Fats (%)	6.00	1.00	6.00	1.00
Crude Fibre (%)	5.00	-	5.00	-
Calcium (%)	1.00	1.00	1.00	0.90
Available Phosphorus (%)	0.40	0.45	0.40	0.35
Lysine (%)	1.20	1.10	0.85	1.00
Methionine (%)	0.35	0.50	0.35	0.38
Salt (%)	0.30	0.20	0.30	0.15
ME (Kcal/kg)	2900	3,200	2900	3,200

*Source: NRC, 1994

Data collection

Body weights of the birds per replicate was taken at the beginning (day old) and every week throughout the experimental period. Weekly feed intake was also measured throughout the period of the experiment by subtracting the feed remaining in feed trough from the feed weighed in at the beginning of the week.

Body weight gain was measured by subtracting the final weight from the initial weight at the beginning of the phase or experimental period. Growth efficiency (GE), protein intake (PI) protein efficiency ratio (PER), Feed conversion ratio (FCR) and energy efficiency ratio (EER) were calculated according to (Ashayerizadeh *et al.*, 2011) as follows:

FI= FO – FR

BWG = FBW – IBW

GE = BWG/IBW

PI = (total feed intake) x (CP% of diet/100)

PER = BWG/PI

FCR =FI/BWG

EER= BWG x (100/TEI)

Where: FI =Feed Intake

FO = Feed Offered

FR = Feed Remaining

FBW= final body weight

IBW= initial body weight

T= time (measured in days)

BWG= body weight gain

TEI= Total energy intake

The percentage difference between the data from birds fed the control diet and the data from birds fed the recommended protease level, was calculated thus:

Percentage difference between treatments = $[\frac{Parameter\ value\ for\ Treatment\ 3}{Value\ for\ Treament\ 1\ (Control)} \times 100] - 100$

It is assumed that data from control treatment 1 represents 100% of values.

The cost of feed consumed was calculated from the unit cost of ingredients and the amount consumed per phase of growth. Profit margin was calculated as the difference between total cost of raising birds from 0-6 weeks and the price of selling birds at the end of 6 weeks (selling price is dependent on the weight of birds). At the end of 6 weeks, birds were collected and weighed on replicate basis.

Statistical analysis

Data generated were subjected to one-way-ANOVA in GLM procedure of SAS (2004) in a completely randomized design. Significant differences among treatment means were separated by Tukey's with probability set at $P<0.05$.

RESULTS AND DISCUSSION

Body weight gain, growth efficiency and protein efficiency Ratio were significantly ($P<0.05$) affected by the addition of protease to the commercial diet (Table 3). Feed intake, energy efficiency Ratio and cost of feed consumed were significantly ($P<0.05$) affected by protease addition. Profitability of supplementing a commercial diet with protease is shown in Table 4. The cost of feeding birds differed significantly across dietary treatment, the selling price and the profit margin were also significantly different at 5% level of probability.

The body weight gain of birds from 0 – 42 days was significantly affected ($P<0.05$) across all treatments. Birds fed 0.5g of protease (T3) had significantly higher body weight gain compared to birds on other treatments though birds fed the control diet performed similarly. Treatment 3 birds had a 5.94% increase in body weight gain when compared to birds fed the standard control diet that is without protease (Table 4) though there was no significant difference between them (Table 3). A look at the feed intake in Table 4, shows a lower feed intake (1.37% decrease) in birds on dietary 0.5g protease when compared to birds fed the control diet but with a significantly different value compared to other treatments (Table 3) and resulting in the lowest cost of production (Table 5). The protein efficiency

Ratio was highest for birds fed 0.5g protease and lowest for birds fed 0.75g protease, this means that birds fed 0.5g protease benefitted most from the diet and were better able to utilize the dietary protein supplied. The birds were most efficient in the use of their available energy and had the best feed conversion ratio. These results were in support of the recommended level of protease inclusion (0.5g/kg of feed) by the manufacturers as birds fed this level performed best in all the performance indices (BWG, FI and FCR) measured or calculated (GE, PER, FCR and EER).

Effect of exogenous proteases added to poultry diets on performance were frequently inconsistent according to Angel *et al.* (2011). In this study, the supplementation of feed with protease did not yield better performance across protease level of inclusions; this was a contradiction to the report of Ajayi, (2015) where a mono-component protease enhanced performance though lower protein levels were fed. Non response of performance of broiler chickens to protease supplementation could be as a result of cereal quality (for example, the complexity of carbohydrate) and the thermo-labile characteristic of enzymes in which case the improvements were not always observed according to Acamovic, (2001). The observed non effect of the protease could also be as a result of the adequacy of the crude protein content of the commercial feed, the availability of the amino acids and their ratio in the basal diet.

The cost of feeding broiler chicks for 6 weeks was lowest in birds fed treatment 4 diet (0.75g protease) (N15,527.28) but this did not result in a corresponding increase in the profit margin because of the lower body weight of birds at the end of the experiment (Table 5). Similarly, the feed cost for birds on treatment 2 diets (0.25g protease) which was similar to feed cost for birds on (0.5g protease) did not result in the best profit margin. The highest feed cost was recorded for birds fed the control diet (₦17,499.60), although the birds had a good selling price but it did not result in the best profit margin. The best profit margin was recorded for birds fed the recommended level of protease (0.5g/kg).

Table 3: Performance and growth indices of Cobb-broiler chickens fed low protein diets supplemented with a mono-component protease (0-42 days)

Parameter	T1(0g)	T2(0.25g)	T3(0.5g)	T4(0.75g)	SEM
Body Weight Gain	2423.60^{ab}	2222.70^{b}	2567.50^{a}	1914.90^{c}	136.17
Feed Intake	5550.90^{a}	5472.20^{a}	5474.90^{a}	4918.70^{b}	184.92
Growth Efficiency	55.08^{ab}	50.51^{b}	58.35^{a}	43.52^{c}	3.09
Protein Efficiency Ratio	2.18^{b}	2.03^{c}	2.34^{a}	1.94^{c}	0.07
Feed Conversion Ratio	2.29^{b}	2.46^{c}	2.13^{a}	2.56^{d}	0.08
Energy Efficiency Ratio	43.61^{b}	40.60^{c}	46.89^{a}	38.95^{d}	1.59

^{abcd} Means in the same row with different superscripts are significantly different at P<0.05, SEM=Standard Error of Mean, T1= Control diet (0g protease), T2=Diet with 0.25g protease, T3=Diet with 0.50g protease, T4=Diet with 0.75g protease; BWG=body weight gain, FI= feed intake, GE= growth efficiency, PER= protein efficiency ratio, FCR= feed conversion ratio, EER= energy efficiency ratio

Table 4: Comparison between the performance of birds fed the control diet and the recommended level of protease

Parameter	T1(0g)	% of T1	T3 ().5g)	% Difference
Body Weight Gain	2423.6	100	2567.5	5.94
Feed Intake	5550.9	100	5474.9	-1.37
Growth Efficiency	55.08	100	58.35	5.94
Protein Efficiency Ratio	2.18	100	2.34	7.34
Feed Conversion Ratio	2.29	100	2.13	-6.99
Energy Efficiency Ratio	43.61	100	46.89	7.52

T1= Control diet (0g protease), T3=Diet with 0.50g protease, BWG=body weight gain, FI= feed intake, GE= growth efficiency, PER= protein efficiency ratio, FCR= feed conversion ratio, EER= energy efficiency ratio

Table 5: Profitability of Cobb-broiler chickens fed low protein commercial diet supplemented with protease

Parameter	T1(0g)	T2(0.25g)	T3(0.5g)	T4(0.75)	SEM
Cost of Feed (₦)/bird	729.15[a]	720.08[a]	718.37[a]	646.97[b]	24.43
**Cost of feed (0-6wk) (₦)	17,499.60[b]	17,281.92[a]	17,240.88[a]	15,527.28[c]	251.43
*Other costs	8,259.69	8,259.69	8,259.69	8,259.69	0.00
**Total cost of production (₦)	25,759.29[b]	25,541.61[a]	25,500.57[a]	23,786.97[c]	456.92
**Selling price (₦)	59,222.86[b]	54,400.38[c]	62,675.71[a]	47,014.29[d]	3392.83
**Profit margin (₦)	33,463.57[b]	28,858.77[c]	37,175.14[a]	23,227.32[d]	3011.01

[abcd] Means in the same row with different superscripts are significantly different at P<0.05, SEM=Standard Error of Mean, T1= Control diet (0g protease), T2=Diet with 0.25g protease, T3=Diet with 0.50g protease, T4=Diet with 0.75g protease; ₦ = Naira (Nigerian currency) *= cost of chicks, medication and labour, ** = All values are per treatment group of 24 birds

CONCLUSION

The profit margin increased with the supplementation of a low CP commercial diet with a mono component protease when broiler chickens were fed for 6 weeks. Birds fed the recommended level of protease (0.5g) benefited most by performing better than birds fed the control diet without protease and also had a significantly higher profit margin. There was no increase in cost of feed as a result of protease addition to the commercial diet used.

REFERENCES

Acamovic, T. (2001). Commercial application of enzyme technology for poultry production. *World's Poultry Science Journal*. (57) 225-242.

Agboola, A. F., Awoyeni M, O., Iyang, U. O. and Ogunbode, S. M. (2014). Growth response and nutrient digestibility of broiler chickens fed wheat-based diets supplemented with an exogenous enzyme. *International Journal of Agriculture and Biosciences.* 3(2): 95-101. www.ijagbio.com

Agboola, A. F., Odu, O., Omidiwura, B. R. O. and Iyayi E. A. (2015). Effect of probiotic, carbohydrase enzyme and their combination on performance, histomorphology and gut microbiota in broilers fed wheat-based diets. *American Journal of Experimental Agriculture*. 8 (5): 307-319.

Ajayi, H. I. and Iyayi, E. A. (2014). Ileal nutrient digestibility and performance in broiler chickens fed graded levels of feather meal. *Ibadan Journal of Agricultural Research*. (10):78-82.

Ajayi, H. I. (2015). Effect of protease supplementation on performance and carcass weight of broiler chickens fed low protein diets. *Nigerian Journal of Agriculture, Food and Environment.* (11)1:29–32.

Angel, C. R., Dalloul, R. A. and Doerr, J. (2005). Performance of broiler chickens fed diets supplemented with a Direct-Fed Microbial. *Poultry Science.* 84: 1222-1231.

Angel, C. R., Saylor, W., Vieira, S. L. and Ward, N. (2011). Effects of a mono-component protease on performance and protein utilization in 7- to 22-day-old broiler chickens. *Poultry Science*. 90: 2281–2286.

Ashayerizadeh, A., Dabiri, N., Mirzadeh, K. H., and Ghorbani M. R. (2011) Effect of dietary supplementation of probiotic and prebiotic on growth indices and serum biochemical parameters of broiler chickens. *Journal of Cell and Animal Biology*. (5) 8: 152-156.

Bedford, M. R. (2000). Removal of antibiotic growth promoters from poultry diets: implications and strategies to minimise subsequent problems. *World's Poultry Science Journal*. 56: 347-365.

Bedford, M. R. (2001). The role of carbohydrases in feedstuff digestion. In: Poultry feedstuffs: Supply, composition, and nutritive value (McNab, J & Boorman, KN eds), CAB international, Edinburgh, UK. pp. 319-336.

Berres, J., Vieira, S. L., Dozier, W. A. III, Cortes M. E. M., DE Barros, R., Nogueira, E. T., and Kutschenko, M. (2010). Broiler responses to reduced-protein diets supplemented with valine, isoleucine, glycine, and glutamic acid. *Journal of Applied Poultry Research.* 19:68–79.

Houshmand, M., Azhar K., Zulkifli I., Bejo M. H. and Kamyab A. (2012). Effects of non-antibiotic feed additives on performance, immunity and intestinal morphology of broilers fed different levels of protein. *South African Journal of Animal Science*. 42 (1):22-32.

Irani, R. S. and Vincent, A. (2011). Autoimmune encephalitis- New awareness challenging questions. Discovery medicine. www.discovery.com/Sarosh-R-Irani/2011/05/17/autoimmune-encephalitis-new-awareness-challenging-question/

Kamran, Z., Aslam, Mirza, M., Ahsan-U. l-Haq., and Mahmood, S. (2004). Effect of decreasing dietary protein levels with optimal amino acids profile on the performance of broilers. *Pakistan Veterinary Journal*. 24:161–164.

Kizerwetter-Swida, M. and Binek, M. (2009). Protective effect of potentially probiotic Lactobacillus strain on infection with pathogenic bacteria in chickens. *Polish*

Journal of Veterinary Science. 12 (1):15-20. PMID: 19459435.

Laudadio, V., Passantino, L., Perillo, A., Lopresti G., Passantino, A., Khan, R. U., and Tufarelli, V. (2012). Productive performance and histological features of intestinal mucosa of broiler chickens fed different dietary protein levels. *Poultry Science* 91:265–270.

Marks, H. L. and Pesti, G. M. (1984). The Roles of Protein Level and Diet Form in Water Consumption and Abdominal Fat Pad Deposition of Broilers. *Poultry Science*. 63: 1617–1625.

Midili, M., Alp, M., Kocabagli, N., Muglali, O. H., Turan N., Yilmaz H. and Cakir S. (2008) Effects of dietary probiotic and prebiotic supplementation on growth performance and serum IgG concentration of broilers. *South African Journal of Animal Sciences*. 38:21-27

NRC, (1994). Nutrient requirements of poultry. Ninth edition

SAS, (2004). General Linear Model statistical package. SAS Users guide Statistics. SAS Inc. Cary, North California.

Thim, K. C., Hamre, M. L. and Coon, C. N. (1997). Responses of broilers to dietary protein levels and amino acid supplementation to low protein diets at various environmental temperatures. *Journal of Applied Poultry Research*. 6:18–33.

Tiwari, S. P., Gendley M. K., Pathak, A. K. and Gupta R. (2010). Influence of an enzyme cocktail and phytase individually or in combination in Ven Cobb broiler chickens. *British Poultry Science* 51(1): 92 - 100

Torres-Rodriguez, A., Sartor C., Higgins S. E., Wolfenden A. D., Bielke L. R., Pixley C. M., Sutton, L., Tellez G. and Hargis, B. M. (2005). Effect of *Aspergillus* meal prebiotic (fermacto) on performance of broiler chickens in the starter phase and fed low protein diets. *Journal of Applied Poultry Research.* 14: 665-669.

Widyaratne, G. P. and Drew, M. D. (2011). Effects of protein level and digestibility on the growth and carcass characteristics of broiler chickens. *Poultry Science*. 90:595–603.

Yang, Y., Iji, P. A. and Choct, M. (2009). Dietary modulation of gut microflora in broiler chickens: a review of the role of six kinds of alternatives to in-feed antibiotics. *World's Poultry Science Journal* 65: 97-114.

Yuan, J., Yao, J., Yang, F., Yang, X., Wan, X., Han J., Wang Y., Chen, X., Liu, Y., Zhou, Z., Zhou, N. and Feng, X. (2008). Effects of supplementing different levels of a commercial enzyme complex on performance, nutrient availability, enzyme activity and gut morphology of broilers. *Asian-Australian Journal of Animal Science* (21) 5: 692 – 700.